(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 709 587 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
01.05.1996 Bulletin 1996/18

(21) Application number: **95912449.6**

(22) Date of filing: **17.03.1995**

(51) Int. Cl.[6]: **F16C 33/10**, F16C 33/12

(86) International application number: **PCT/JP95/00469**

(87) International publication number:
WO 95/25906 (28.09.1995 Gazette 1995/41)

(84) Designated Contracting States:
DE GB

(30) Priority: **18.03.1994 JP 73965/94**

(71) Applicant: **TAIHO KOGYO CO., LTD.**
Aichi 471 (JP)

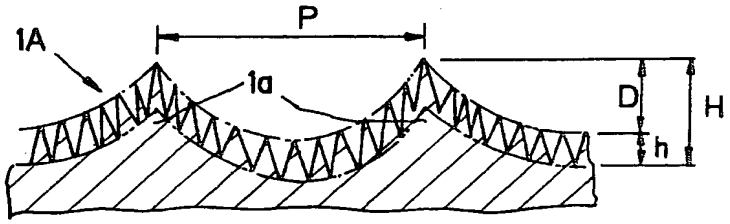
(72) Inventors:
- **SHIBATA, Makoto**
  Taiho Kogyo Co., Ltd.
  Aichi 471 (JP)
- **TAKAHASHI, Masao**
  Taiho Kogyo Co., Ltd.
  Aichi 471 (JP)

(74) Representative: **Paget, Hugh Charles Edward et al**
MEWBURN ELLIS
York House
23 Kingsway
London WC2B 6HP (GB)

(54) SLIDING BEARING

(57) A slide contacting surface (1A) of a sliding bearing (1) has ridges (1a) extending continuously and helically at a predetermined pitch p. The roughness h of the slide contacting surface (1A) including the ridges (1a) is set not more than a half of the height (H) of the ridges (1a). This enables a sliding bearing (1) of an excellent compatibility to be provided.

FIG. 2



EP 0 709 587 A1

Printed by Rank Xerox (UK) Business Services
2.11.3/3.4

Description

Technical Field

The invention relates to a sliding bearing, and more particularly, to a sliding bearing having an annular projection formed on a sliding surface thereof.

Background

A sliding bearing having an annular projection formed around its sliding surface is disclosed, for example, in Japanese Patent Publication No. 11,530/1988. However, in the disclosed sliding bearing, no consideration is paid to the relationship between a roughness of the sliding surface including the surface of the annular projection and the height of the annular projection.

Disclosure of the Invention

The present inventor has found that running-in performance of the sliding surface of a sliding bearing can be improved by a suitable choice of the roughness of the sliding surface, including the surface of the annular projection, and the height of the annular projection. Specifically, in a sliding bearing having a plurality of annular projections formed to a given height around the sliding surface, in accordance with the invention, the roughness of the sliding surface including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections. With this arrangement, the running-in performance of the sliding bearing can be improved over the prior art, as will be demonstrated by results of experiments conducted, which will be described later.

Brief Description of the Drawings

Fig. 1 is a perspective view of a sliding surface of a sliding bearing according to one embodiment of the invention;

Fig. 2 is an enlarged view of part shown in Fig. 1;

Fig. 3 graphically demonstrates differences in construction between a product according to the invention and controls 1 and 2;

Fig. 4 is a chart indicating results of a test conducted concerning the running-in performance of the sliding bearing; and

Fig. 5 graphically shows results of tests conducted to examine the running-in performance of the sliding bearing.

Best Mode for Carrying Out the Invention

The invention will now be described with reference to an embodiment shown in the drawings. Fig. 1 is a perspective view of a sliding surface 1A of a sliding bearing 1. In this embodiment, a projection 1a which continues in a helical form is formed at a given pitch p and to a height H around the sliding surface 1A.

As shown to an enlarged scale in Fig. 2, in this embodiment, the height H of the projection 1a is chosen in a range from 2 to 8 μm, and the pitch p is chosen in a range from 0.1 to 0.4 mm. Preferably, $h \leq 0.25H + 0.5$, while H ranges from 2 to 10 μm. More preferably, the height H is chosen in a range from 3 to 5 μm in favor of the load capacity. h shown in Fig. 2 represents a surface roughness over the entire sliding surface 1A.

In this embodiment, the surface roughness h over the entire sliding surface 1A, including the surface of the projection 1a, is chosen to be equal to or less than one-half the height H of the projection 1a. Thus, when a height H of 4 μm is chosen for the projection 1a, the surface roughness h over the entire sliding surface 1A is chosen to be equal to or less than 2 μm.

In Fig. 3, the surface roughness h over the sliding surface 1A, taken on the ordinate, is plotted against the height H of the projection 1a, taken on the abscissa, in order to demonstrate differences in the construction between the product according to the invention and controls 1 and 2. An experiment to determine the running-in performance has been conducted for the sliding bearing 1 and the controls 1 and 2, exemplified in Fig. 3, and results are shown in Figs. 4 and 5.

Fig. 4 indicates the evaluation of the abutment experienced by the inner surface of the sliding bearing when a crankshaft of an engine is journalled therein at 30 minutes after the start of operation. In Fig. 4, samples A, B and C are sliding bearings manufactured according to the invention, so that the surface roughness h is equal to or less than one-half times the height H of the projection 1a, and samples a, b and c are of the control 1, representing sliding bearings in which the surface roughness h of the sliding surface is greater than one-half the height H of the projection 1a. The control 2 represents a sliding bearing in which the sliding surface is finished flat by a conventional boring operation. In this instance, the height H which is equivalent to the height of the projection 1a is substantially on the same order as the surface roughness h or about 2 μm, and there is essentially no difference therebetween. As will be noted from Fig. 5, the remaining oil amount is reduced and has a large variation for the control 2. It will be seen from Fig. 4 that the samples A, B and C according to the invention provide better results than the controls 1 and 2 in respect of the abutment.

Fig. 5 shows results of experiments conducted to determine the amount of a lubricating oil which is retained by the sliding bearing when the engine is restarted. It will be seen from Fig. 5 that the retention of the lubricating oil of the samples A, B and C according to the invention is by 20 to 30% higher than that of the control 1. In addition, a variation in the amount of remaining oil is reduced in the samples according to the invention, and in these samples, such amount is on the order of twice that of the control 2. In this manner, the present

embodiment provides an improved running-in performance of the sliding bearing 1.

In the embodiment described above, the projection 1a is formed so as to be continuous in a helical configuration, but a plurality of annular projections which are spaced apart axially at a given pitch may be used instead as well.

Claims

1. A sliding bearing having a plurality of annular projections formed to a given height around a sliding surface; characterized in that a surface roughness of the sliding surface, including the surface of the annular projections, is chosen to be equal to or less than one-half the height of the annular projections.

2. A sliding bearing according to Claim 1 in which denoting the height of the projection by H and the roughness by h, these parameters are related by the following inequality:

$$h \leq 0.25H + 0.5$$

3. A sliding bearing according to Claim 1 or 2 in which the height of the projection is in a range from 2 to 10 µm.

4. A sliding bearing according to Claim 1 or 2 in which the height of the projection is in a range from 3 to 5 µm.

5. A sliding bearing according to one of Claims 1 to 4 in which the pitch between axially adjacent projections is in a range from 0.1 to 0.4 mm.

FIG. 1

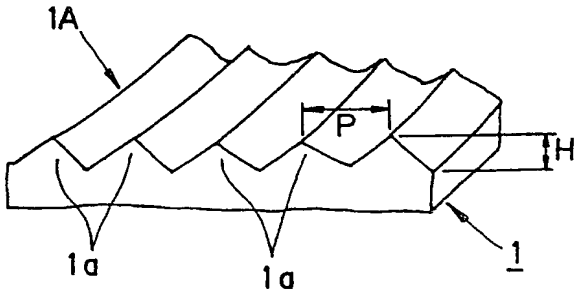


FIG. 2

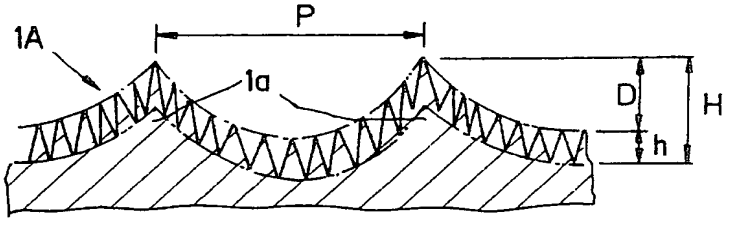


FIG.3

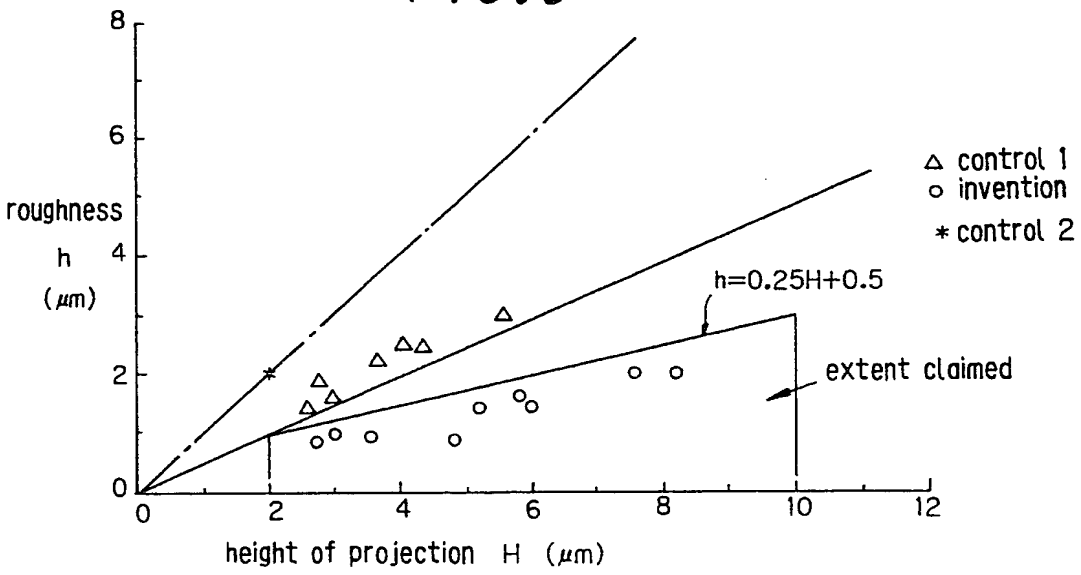


FIG.4

abutment against inner surface of bearing at 30 minutes after starting a running-in operation of an engine

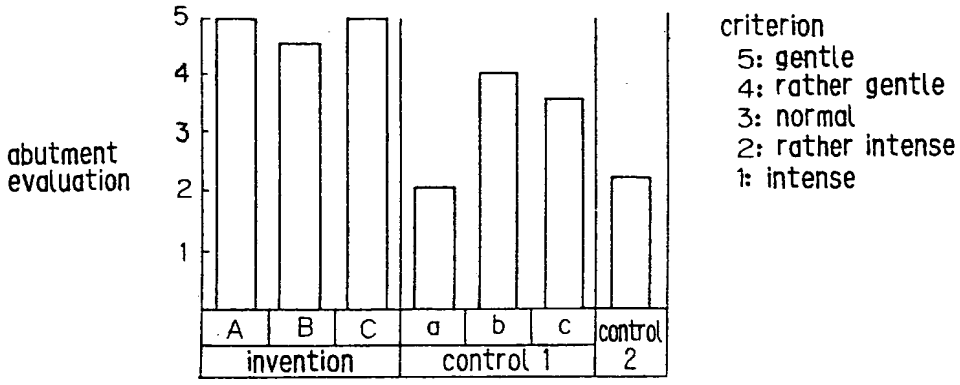
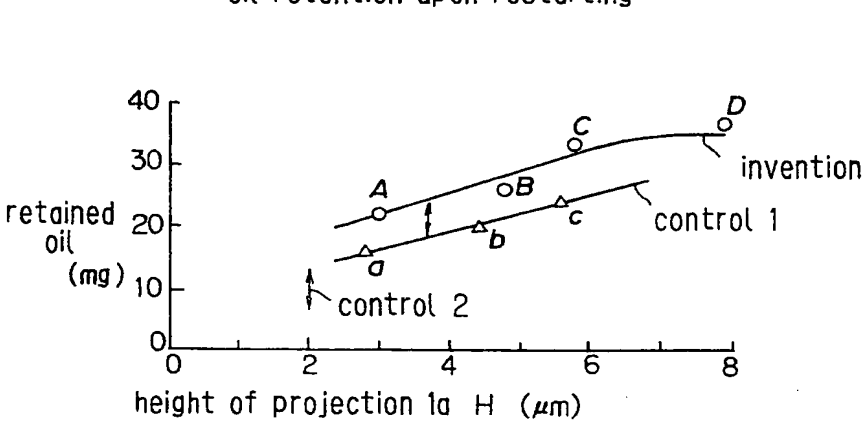


FIG.5


oil retention upon restarting
retained oil (mg)
40
30
20
10
0
0
2
4
6
8
A
B
C
D
a
b
c
invention
control 1
control 2
height of projection 1a H (μm)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP95/00469

A. CLASSIFICATION OF SUBJECT MATTER

Int. Cl^6 F16C33/10, 33/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int. Cl^6 F16C33/10, 33/12

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1926 - 1995
Kokai Jitsuyo Shinan Koho 1971 - 1995

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP, 4-39461, Y (Toyota Motor Corp., Taiho Kogyo Co., Ltd.), September 16, 1992 (16. 09. 92), Line 16, column 2, page 1 to line 26, column 3, page 2 (Family: none)	1 - 5
Y	JP, 63-30619, U (Toyota Motor Corp., Taiho Kogyo Co., Ltd.), February 29, 1988 (29. 02. 88), Claim (Family: none)	1 - 5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
June 12, 1995 (12. 06. 95)	July 4, 1995 (04. 07. 95)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)